

Some Kind of Drifts Newly Observed in QA Activity for Linac

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Introduction

To deliver prescribed dose to target volume exactly in both geometry and dose, radiotherapy physicists perform their own QA program for medical linear accelerators on periodic basis and after repair. They test various items which are selected on a recommendation of national or international organization. The QA program of a linear accelerator depends on the organization but the test items are similar for the most part. Naturally, QA program of a linear accelerator includes dosimetric parts and mechanical parts.

Slight change of a machinery part could be overlooked in both QA activity and daily operation, if any test of the part is not considered in both organizational recommendation and manufacturer's recommendation. Even though change of the machinery part is tiny, the change could seriously affect patient positioning and patient dose. The possibility overlooking even large change could not be completely ruled out.

We have experienced change of some machinery parts, of which the test is not considered in the QA program of our department. Asymmetric field in symmetric mode of independent jaw system, shift of wedges, and drift motion of couch in gantry mode are observed.

Detection of the errors is described. The chances for them to be detected, problems related to the change, and the cause and action to prevent occurrence of the change of machinery parts are described.

Finding change of machinery parts

We have 3 units of different model from one company.

Asymmetry in symmetric mode: In symmetric mode of independent jaw system, asymmetric field was observed by the merest chance. In symmetric mode, one jaw either moved slowly comparing the opposite jaw or stopped. There was also the case that difference of position of corresponding jaws is larger than 10 cm at 100 cm SSD. Even in this case, digital value of field size indicated jaw opening at SAD and

correct.

Couch drift: SSD of 5-year-old unit was slightly changed after collimator rotation or changing field size. When testing the fixation of table top, the top very slowly moved up. The speed of top movement was not constant. Even though pressing only deadman switch on gantry mode, the table top was moved.

Wedge shift: Wedge should be fixed in its holder for safety and consistent dose. Shift of wedges of the oldest therapy unit was observed in testing their fixation in the wedge holder.

Problems related to the change

Asymmetry in symmetric mode and couch drift: The radiation field does not cover some part of target volume while some normal tissue could suffer unnecessary radiation.

Wedge shift: Uncertainty in dose could be increased.

Cause and action against the problems

Asymmetry in symmetric mode: Even symmetric mode, jaw driving system is an independently moving type. Bearing belonging to one jaw was broken, so the bearing was replaced.

Couch drift: There was leakage of electric current in wiring connecting gantry and couch.

Wedge shift: Wedge factors at d_{max} were measured for their innermost and outermost position in both inner and outer direction of wedge blade. Maximum difference relative to the mean of transmission factor of each wedge generally increases with wedge angle. The largest uncertainty was 4.8%. For each wedge, wedge factor at outermost position is close to mean. Radiation therapists should put wedge at its outermost position.

CI-6X

Angle	Code: Odd		Code: Even		Average	Rel Max Diff (%)
	Inner	Outer	Inner	Outer		
15°	0.819	0.826	0.832	0.824	0.825	0.8
30°	0.772	0.789	0.802	0.787	0.788	2.0
45°	0.589	0.616	0.637	0.610	0.613	3.9
60°	0.437	0.461	0.480	0.459	0.459	4.8

CI-4X

Angle	Code: Odd		Code: Even		Average	Rel Max Diff (%)
	Inner	Outer	Inner	Outer		
15°	0.809	0.804	0.803	0.807	0.806	0.4
30°	0.694	0.685	0.681	0.687	0.687	1.1
45°	0.562	0.544	0.531	0.546	0.546	3.0
60°	0.396	0.390	0.378	0.391	0.389	2.8

Code: wedge code defined by the manufacturer;
 Inner: innermost position; Outer: outermost position;
 Rel Max Diff: maximum difference relative to average